HUDBAY

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Memo

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From:	Clarissa Barraza, Matt Cunningham
Department:	Environmental, Geology, Engineering
Date:	11Oct2021
Subject:	Using fugitive limestone silt from Imerys limestone quarry to extrapolate the potential range of transport from the Rosemont Copper World Project site via ephemeral washes.

SUMMARY

One of the key parameters in determining whether the ephemeral washes on Rosemont Copper World Project (Project) site's private land are considered jurisdictional under the Clean Water Act is whether there is a "significant nexus" with a downstream "traditionally navigable water" (TNW). In other words, the on-site washes could be jurisdictional waters if they have a physical, biological, and chemical connection to a downstream TNW. The purpose of this memorandum is to analyze the transport of fugitive limestone silt from the Imerys limestone quarry as a prudent proxy for other potential contaminants to inform on the "physical connectivity" of the Project area to downstream waters. Potential contaminants from a future Hudbay operations would likely have a density more than twice higher than limestone powder and as such be transported over shorter distances.

Rain events in this region are episodic, of varying duration and volumes. Since the Imerys quarry has been in operation for approximately 50 years, it has experienced a wide range of rain events. Therefore, it is appropriate to evaluate the transport distance of the uncontrolled fugitive limestone silt from the site as representative of the potential for contaminants to be washed downstream from the area in general.

This study quantitatively assesses the conveyance of the limestone powder down the ephemeral wash from its source, the Imerys Mine. The Imerys quarry is directly adjacent to the Project area and shares the same washes draining the area during storm events. The surface water features found in the area allow rainwater to eventually discharge into the Santa Cruz River although depending on the travel distance, volume and flowrate. Analysis of aerial photography, combined with ground surveys, indicate that the maximum reach of fugitive limestone silt from the Imerys quarry (either through suspended particles or soluble solution) is approximately 8 miles downstream (see Figure 1).

Potential contaminate sources from the Project could be sulphide or oxide particles in granular form that may be transported down the ephemeral washes during storm events. Those particles, by their chemical nature, have a greater specific gravity than the limestone silt and are therefore expected to travel shorter distances than the limestone silt granules. Another mode of transport of these potential contaminants is in solution where the contaminants travel until pH conditions change thereby causing precipitation or flowing until the flow stops and precipitate occurs due to evaporation. Evaporation is a major contributor to changes in pH, and given the consistent make-up of the limestone silt, precipitation in this case is more likely due to water evaporation.

The precipitated residue accumulation (i.e., calcite) was analyzed microscopically to determine if the residual calcite marker noted in the washes were:

1. silty granules settled in drying puddles; or

2. crystalline in nature, thus reflecting calcium in solution precipitating as water dried up in the furthest reaches of the water flows.

In summary, the furthest distance where the presence of limestone silt is found would indicate the maximum distance that the water could carry particles lighter (less dense) than the expected particles from the Project deposits. Additionally, in the case of precipitates distinct to Imerys it would indicate the maximum distance water travelled from the origin, which could potentially host contaminants from the Project in aqueous form. In either case, the unique characteristics and purity of the Imerys quarry limestone silt serves as an ideal visual marker for tracing transport due to storm flow events over the quarry's 50-year history.

The results of this study indicate no evidence of limestone past 8 miles downstream of the ephemeral washes. Neither visible calcite in any form, including precipitated calcite, was detected (through imagery, ground survey and microscopically) at the sample Point 3 which is 7.38 river miles from the source supporting the conclusion. Therefore, sediment fugitives from the Project will not have the ability to be transported by the washes to the Santa Cruz River nor to any traditionally navigable water.

DESCRIPTION

Imerys Mine is a marble-limestone quarry located 15 miles southeast of Sahuarita and located northwest of the Rosemont Copper World Project. Imerys operations, which have owned the mine since 1997, produces limestone for distribution. This area has been mined for limestone since 1972; previously owned by Homestake Productions. The limestone (primarily calcium carbonate) residue can be seen throughout the area as a white powder that is carried downstream in the ephemeral washes during storm events.

The study area, seen in Figure 1, includes the Imerys Mine and the downstream drainages where samples have been taken at different points (1, 2, & 3). In addition, at approximately 1.85 miles downstream of the Imerys Mine, a short distance past Sample Point 2, the drainage is along the edge of a small hill mapped as Pennsylvanian Horquilla Formations, a limestone and siltstone bearing formation (Figure 2). This outcrop, although undisturbed, could potentially contribute additional calcium carbonate material, either dissolved, or as suspended load, during rain events; albeit expectedly minor compared to the broken crushed limestone material originating from the Imerys Mine. It is important to recognize that these contaminants added to the flow may revitalize the silt allowing the perceived travel distance from Imerys to increase. The study did not take into consideration the possibility that at the 1.85 mile mark additional limestone is added to the flow. It is assumed that all the contaminants are from the Imerys mine and conservatively traveled the full 8 miles.

This study used the presence of limestone sands and fine limestone residue as a visual indicator of the process of physically moving particles through the drainages (washes). The limestone residue results in a white or lighter color on google earth imagery and can be distinguished from those washes that do not carry limestone silt; this was used to determine the path of limestone transport. By comparing the samples and site photos taken at 3 different locations, and the aerial photography from google earth (imagery 2020), there is quantitative confirmation that the limestone silt traveled downstream about 8 miles; 7.54 river miles for path A, 7.38 river miles for path B.

The paths seen in Figure 1, (Path A and Path B), were chosen by following the white/light color limestone silt as it traveled downstream in the ephemeral washes. The source at Point 1, taken at about 0.5 road miles from the quarry, was chosen due to the abundance of limestone powder. The ephemeral wash was followed downstream until it reached a fork. The wash diverged at the fork and the path was split between paths A and B. Both paths were traced and at about 7 to 8 river miles the color of the washes in the imagery was similar to the colors in the surrounding area washes, this was evidence that the limestone had not reached those points in significant enough quantities to be visually observable.

As stated, the first sample (Point 1) was taken at about 0.5 road miles from the Imerys quarry due to the high amount of contaminant. Point 2 sampling was downstream of Point 1, about 2 river miles distant. Point 2 was chosen as sporadic deposits of calcite were present as indication of precipitation. Point 3 was taken at a wash near Wilmot Road, northwest of Point 2, where the color was found to be the same as the surrounding area washes and had no indication of the presence of limestone. The area surrounding the wash at Point 3 is a residential area and highly disturbed with a road separating the drainage.

Ground investigations were completed that included taking photographs at the 3 sample points. The sample points were chosen through Path B to provide evidence that the imagery was reflective of the silt's flow pattern. Samples from these areas were also evaluated microscopically. At each sample point, 2 specimens were taken, a "Loose

Sand Sample" and a "Compacted Soil/Solid Sample". The "Loose Sand Sample" was taken to investigate the distance the limestone powder travels through suspension in stormwater flow. The "Compacted Soil/Solid Sample" was taken to investigate the travel distance of soluble calcium carbonate as it precipitates and is deposited downstream; note that calcium carbonate is the cementing agent that binds soil particles together and produces a stable soil structure.

Figure 1 – Study Area Map, Sample Points and Paths

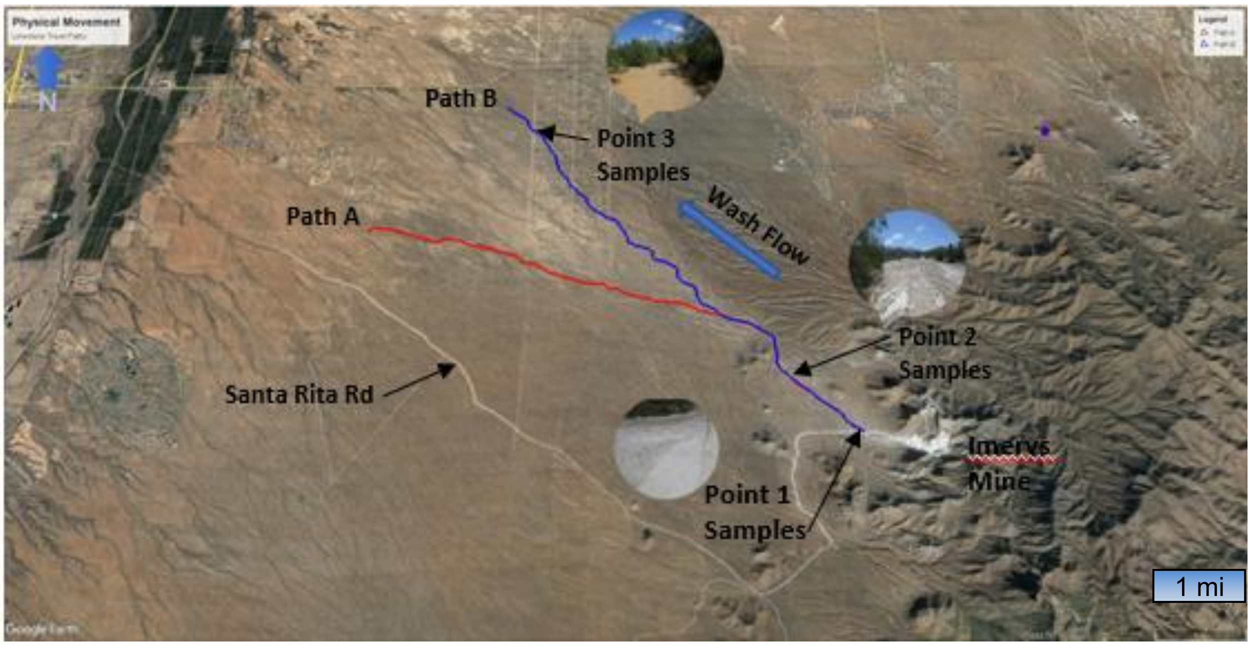
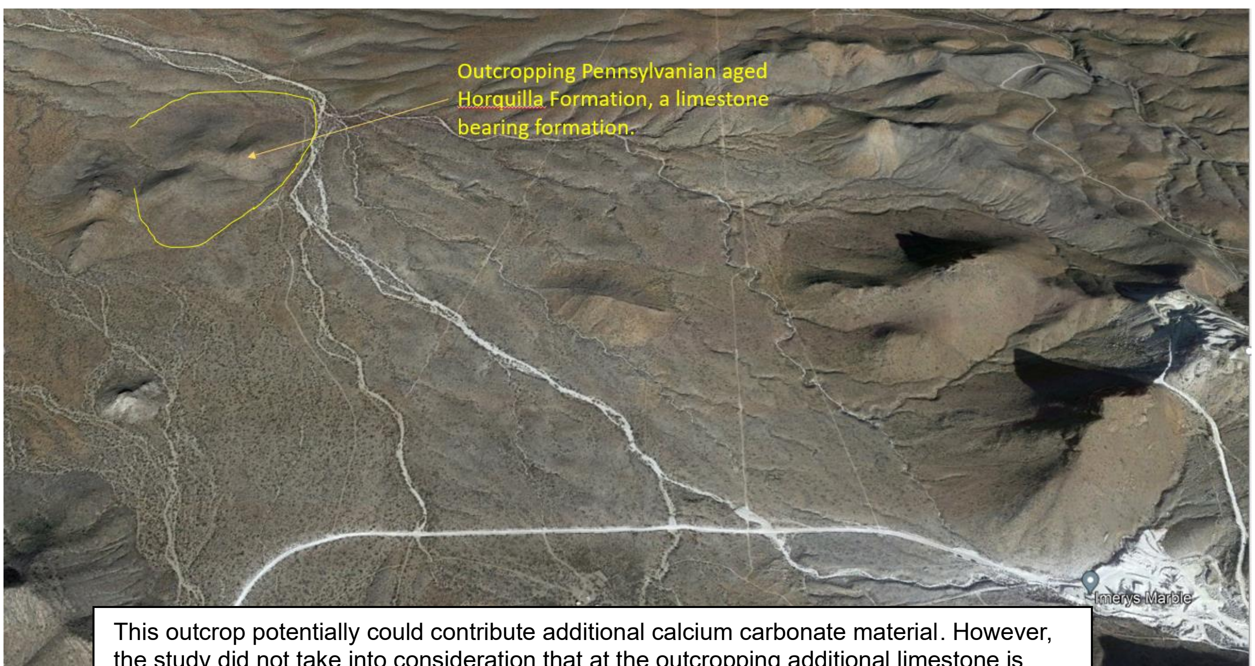


Figure 2 – Study Area Map, Pennsylvanian Horquilla Formation



This outcrop potentially could contribute additional calcium carbonate material. However, the study did not take into consideration that at the outcropping additional limestone is added to the flow. It is assumed that all the contaminants are from the Imerys mine and conservatively traveled the full 8 miles.

TRANSPORT METHODOLOGY

1. Method: Suspension of Limestone

One method of conveying calcium carbonate is through the suspension of limestone powder in water during storm flows. The bulk density of pulverized limestone is about 68 lb/ft^3. As compared to water (62.4 lb/ft^3), the limestone powder has a specific gravity of 1.1 which indicates that the powder is easily suspended in water. Any substance with the specific gravity less than one (1) will be suspended in water. The closer a substance is to one (1) the easier the material will transport. As a reference, fine sand has a bulk density of 125 lb/ft^3 (SG of 2.0).

Sediment transport occurs when particles (sands, grains, etc.) are entrained with water and the flow suspends the particles with enough velocity to move them. Typically for fine solids, the minimum flow velocity needed for suspension is 3-5 ft/s. Thus, during the storm flows and with its specific gravity, the limestone powder will flow down the wash until the velocity is under 3 ft/s at which point the material will settle out the granular residue and leave the white/lighter markings in the drainage.

Rosemont's 43-101 Technical Report identifies specific gravities per lithology found in the Project area, see reference section. The sulfide specific gravity mean ranges from 2.4 to 2.6. A chart of different material bulk densities is also provided in the reference section. Again, all of these denser materials will settle out of flowing water much earlier than the limestone powder with a specific gravity of just over one (1).

2. Method: Soluble Limestone

The solubility properties of calcium carbonate also contribute to the conveyance and deposition of the white limestone silt. Limestone, composed of calcium carbonate, forms in marine settings which typically have a pH of 8 or greater (slightly basic). Calcium carbonate in neutral water (pH 7) has a low solubility but solubility increases with increased acidity. Rainwater is weakly acidic (typically pH of 5.0 – 5.5 due to carbonic acid generated from dissolved CO_2). When rainwater is added to limestone, some of the calcium carbonate reacts to form a calcium bicarbonate solution. As the water evaporates it leaves behind a calcium carbonate deposit. This deposit solidifies as sheets and films. Similarly, the sample taken at point 1 was magnified at 40 times and the structure was found to be smooth and layered; like a stalagmite. It was also noted that the calcite solids (crystals) that did not dissolve in the solution and were moved via sediment transport were encapsulated in the sheets/films.

As the solution moved downstream and evaporation occurred, deposition became sporadic and encapsulated other sediments found naturally in washes. The sample color (as well as the surrounding area) was not as white as before and the magnified sample structure did not have the smooth texture found where there was an abundance of calcium carbonate.

OBSERVATIONS

The results of all 6 samples, two (2) at each Point, are summarized in Figure 3.

Samples taken at Point 1 where the limestone concentration was high had both methods of transport (suspension of limestone and soluble limestone, as well as bed load transport). Bed load transport includes larger particles that are transported along the stream bed. The Point 1 area was covered in white limestone powder, see the reference photos in the Imagery Section. The limestone powder (Loose Sand Sample), when magnified 40 times, showed the loose calcite crystals which are carried as sediment transport. The magnified Compacted Soil/Solid Sample, where precipitation occurred as weak calcitic cement, had a smooth layer and was solid with some crystals encapsulated. The silt to coarse grained sand in the samples is entirely limestone, marble, or calcite. Poor sorting and angular nature of sand particles indicate a short transport distance from the source. This area clearly exhibited both the suspension of limestone and soluble limestone.

The Compacted Soil/Solid Sample taken at Point 2 had the calcitic cementing of both silt to very fine grained polymictic sand and gravel size grains and the precipitated limestone. Very little limestone powder was found, and the Loose Sand Soil Sample exhibited less calcite crystals and more of the wash's sand sediments. The polymictic nature of the Loose Sand (more than one lithology present, though still dominantly limestone), more grain rounding (grains sub-angular to sub-rounded), and stronger grain sorting than the samples from Point 1 (silt to very fine-grained sand overall), indicates further transport distance from the source material. The results from this area indicate that the sporadic white patches were mostly made up of precipitated limestone and the darker color of the sand suggests a decrease in the suspension of limestone powder and its downgradient transport.

Samples taken at Point 3 did not have the noticeable white markings that were indicative of Points 1 and 2. The brown color of the wash was representative of the rest of the area. The Loose Sand Soil Sample is polymictic, made up of fine to coarse grained sub-angular to sub-rounded quartz, feldspar, granitic fragments, and mafic rocks; very notably no limestone, marble or calcite grains are observed. The Compacted Soil/Solid Sample had the texture of dried mud and under magnification showed no visual evidence of calcitic cementing with sand. The make-up of the Compacted Soil/Solid Sample is very similar to the Loose Sand Soil Sample.

The makeup of the samples from Point 3 indicate that no limestone is carried via sediment transport or suspended load from Imerys to this location.

CONCLUSION

The analysis from the scale of aerial imagery to the microscope analysis of samples indicate that the crushed and exposed limestone material from the Imerys quarry does not travel via suspended load nor sediment transport to Sample Point 3. Visible calcite in any form, including precipitated calcite, is not observed at Sample Point 3.

Since the limestone's signature decreases as the wash moves downgradient from the source point it is evident that the storms for over 50 years have not contributed to the transportation of limestone silt beyond the 8 miles. It can then be concluded that at the Santa Cruz River (37 river miles downgradient) there are no fugitive limestone contaminants from the source point; neither suspended nor soluble. Therefore, sediment fugitives from the Project will not have the ability to be transported to the Santa Cruz River nor to any traditionally navigable water.

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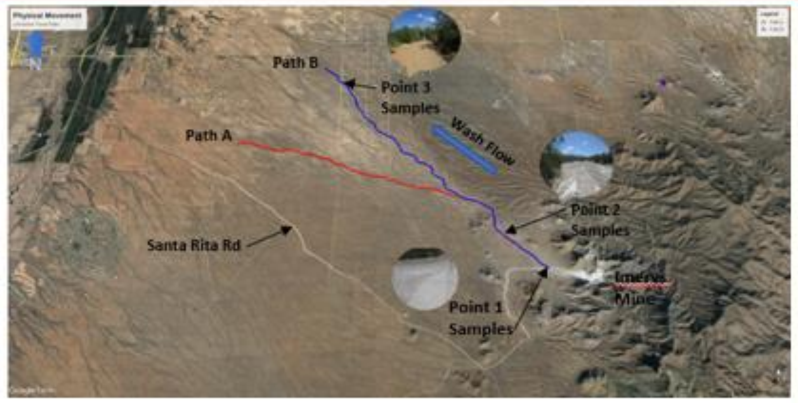
Figure 3 – Study Results Summary

Orthographic Study Summary Limestone Dispersion



Methodology:

The Imerys quarry's limestone was used as an indicator of sediment transport. Using google imagery, the water flow was followed through the wash by using color to distinguish where the water transported the limestone, either by depositing silt as precipitate or by sediment transport. The path began at the highest contaminated area wash, 0.5 miles away from the Imerys quarry. The wash came to a fork and two paths were followed, Path A and B (Fig. 1). At about 8 river miles, the color of the imagery was similar to the colors in the surrounding washes at both paths, evidence that the limestone had not reached those points. Ground investigations were completed, and three (3) samples were chosen through Path B to provide evidence of the flow pattern and evaluated microscopically. At each sample point two (2) specimens were taken, a "Loose Sand Sample" and a "Compacted Soil/Solid Sample". The "Loose Sand Sample" was taken to investigate the distance the limestone powder travels through suspension in stormwater flow. The "Compacted Soil/Solid Sample" was taken to investigate the travel distance of soluble calcium carbonate as it precipitates and is deposited downstream. Below are the results of the investigation.

Imerys Quarry

Point 1 Sample

Sample 1 taken at the contaminated wash.

0.5 road mi

Point 2 Sample

Sporadic deposits in the wash looking Southeast at Sample 2.

2.0 river mi downstream

Point 3 Sample

Dark area depicting typical wash color as Sample 3.

7.4 river mi downstream

Santa Cruz River

Approx. 37 river mi

Loose Sand Sample

Point 1

Description:
Loose solid Calcite crystals, white powdery, easily dispersed.

Lithology	Limestone, Marble, Calcite
Cement	Weak Calcitic
Grain size	Silt-CG (pebble)
Sorting	Poor
Color	White
Rounding	Angular

Point 2

Description:
Coarser sand with few Calcite crystals, tan in color and denser than Point 1 sample.

Lithology	Poly-metic, however dominantly calcitic (limestone)
Cement	Local weakly calcite cemented clumps
Grain size	Silt-vfg (mg)
Sorting	Good
Color	Tan
Rounding	Subangular to subrounded

Point 3

Description:
Loose sand with various sediments, darker in color as compared to the other samples.

Lithology	Poly-mictic, quartz, feldspar, mafic clasts, granitic fragments, no limestone or calcite grains observed.
Cement	None
Grain size	fg-cg (pebble)
Sorting	Moderate
Color	Brown
Rounding	Subangular to subrounded

Compacted Soil/Solid Sample

Point 1

Description:
Soft rock solid smooth textured, white with encapsulated crystals.

Lithology	Limestone, Marble, Calcite
Cement	Local weak Calcitic
Grain size	Silt-vfg; vcg-grav
Sorting	Bimodal
Color	White
Rounding	Angular, euhedral calcite crystals

Point 2

Description:
Soft, solid other wash sediments; cementing with color has darker tint.

Lithology	Poly-mictic, however dominantly calcitic (limestone)
Cement	Local weakly calcite cemented clumps
Grain size	Silt-cg (gravel)
Sorting	Poor
Color	Tan
Rounding	Subangular to subrounded

Point 3

Description:
Soft mud like solid with no encapsulated Calcite crystals. Darker color than other samples.

Lithology	As above including friable clumps with calcitic cement
Cement	Mud like hardened clumps
Grain size	fg-cg (pebble)
Sorting	Moderate
Color	Brown
Rounding	Subangular to subrounded

Conclusion

	Point 1	Point 2	Point 3
Conclusion	Limestone is prevalent in this area based on evidence (white color, photos, samples). Both suspended and soluble limestone is found in abondance thus, any storm event would carry the limestone downgradient.	There is sporadic evidence of calcite precipitation with cementing sand grains which indicates a decrease of limestone. The investigation concludes that only larger storm events in the last 50 years would be able to carry the limestone from point 1 to point 2.	Color is very indicative that there is no presence of limestone as the wash is the same color as the surrounding areas. This area has none of the characteristics of pure limestone and rain events would not carry the source limestone to this point.

Conclusion:

Since the limestone's signature decreases as the wash moves downgradient from the source point and there was no evidence of Imerys' contaminant at about 8 miles, then it can be concluded that at the Santa Cruz River (37 river miles) there will be no contaminants from the source point limestone.; neither suspended nor soluble. Therefore, sediment fugitives from the Project will not make it to the Santa Cruz river or to any traditionally navigable water.

RCC-CW017791

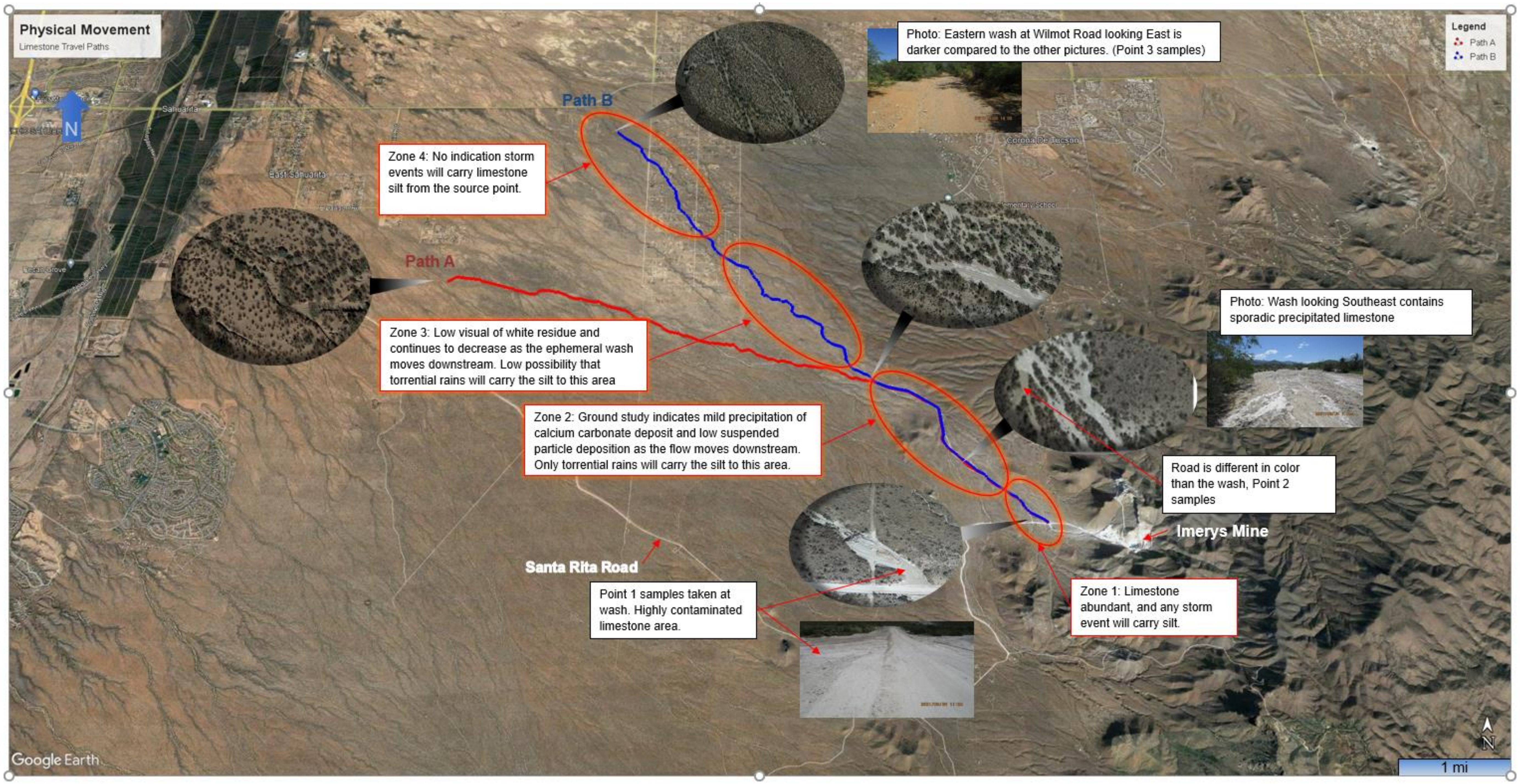
IMAGERY SECTION

The google earth imagery dated 12/18/2020 was used in this study. The images illustrates that visually the limestone silt can be easily traced. These images are of the washes and where selected at different points throughout the path to demonstrate, in more detail, the deposited limestone silt. This silt slowly fades the further it moves downstream from the source. At about 8 miles downgradient from the Imerys mine the residue becomes visually unremarkable. Some of the points noted on the map also include photos taken at the sampling points for comparison to the google imagery at those same areas.

Point 1
Google areal imagery indicates most of this area has a top layer of limestone from the Imerys quarry (quarry is less than 1 mile away). Site picture confirms the area is covered with limestone residue.

Point 2
Site Picture confirms the visual white residue from google map. The road going into the wash is darker than the white patches and clearly indicates the limestone traveled downstream and not onto the road.

Point 3
Site Picture confirms the google areal imagery that there is no visual white silt. The picture to the right is the typical soil sediment seen in the area washes.



RCC-CW017792

REFERNCES

Rosemont Project, NI 43-101 Technical Report, Feasibility Study, Revision 3, Effective date of March 30, 2017, page 14-37, Table 14-23.

SPECIFIC GRAVITY MEASUREMENTS PER LITHOLOGY AND OXIDATION STATE

Oxide	Granodiorite	Bolsa	Abrigo	Martin	Escabrosa	Horquilla	Earp (Lower)	Earp (Upper)	Epitaph	Scherrer	Glance	Gila	Arkose	Andesite	QMP
Assays	0	54	15	102	210	761	209	47	505	427	114	47	969	138	649
Missing Values	39	297	302	285	480	1635	223	164	394	858	227	10	1541	405	444
Minimum		2.52	2.76	2.43	2.45	2.01	2.45	2.27	2.44	2.36	2.35	2.21	2.13	2.36	2.11
Maximum		3.4	3	3.01	3.2	3.33	3.54	3.26	3.12	3.18	3.28	2.61	3.43	3.08	3.09
Mean		2.637	2.851	2.713	2.712	2.778	2.844	2.738	2.766	2.787	2.689	2.387	2.599	2.625	2.562
1st Quartile		2.56	2.82	2.64	2.65	2.69	2.73	2.56	2.68	2.72	2.47	2.35	2.54	2.56	2.49
Median		2.61	2.84	2.7	2.7	2.78	2.82	2.73	2.8	2.77	2.72	2.38	2.59	2.63	2.52
3rd Quartile		2.67	2.89	2.78	2.76	2.86	2.95	2.91	2.86	2.85	2.85	2.42	2.64	2.68	2.58
Std. Devn.		0.16	0.066	0.098	0.09	0.121	0.172	0.228	0.135	0.13	0.206	0.059	0.124	0.095	0.135
Variance		0.026	0.004	0.01	0.008	0.015	0.029	0.052	0.018	0.017	0.043	0.003	0.015	0.009	0.018
Co. of Variation		0.061	0.023	0.036	0.033	0.044	0.06	0.083	0.049	0.047	0.077	0.025	0.048	0.036	0.053

Mixed	Granodiorite	Bolsa	Abrigo	Martin	Escabrosa	Horquilla	Earp (Lower)	Earp (Upper)	Epitaph	Scherrer	Glance	Gila	Arkose	Andesite	QMP
Valid	7	72	32	96	16	284	203	176	254	359	25	10	1,701	139	219
Rejected	17	90	98	212	115	759	250	222	464	281	21	172	2665	216	335
Minimum	2.54	2.39	2.53	2.46	2.54	2.3	2.49	2.39	2.21	2.41	2.4	2.23	1.97	2.42	2.35
Maximum	2.59	2.86	2.87	2.96	2.91	3.26	3.32	3.07	2.98	3.19	2.95	2.8	3.16	2.95	2.87
Mean	2.55	2.579	2.691	2.711	2.736	2.811	2.879	2.646	2.689	2.709	2.679	2.375	2.578	2.67	2.543
1st Quartile	2.54	2.53	2.62	2.64	2.68	2.72	2.77	2.55	2.59	2.64	2.44	2.26	2.51	2.6	2.48
Median	2.54	2.59	2.66	2.7	2.7	2.8	2.87	2.62	2.72	2.7	2.76	2.36	2.58	2.66	2.53
3rd Quartile	2.55	2.62	2.71	2.79	2.78	2.9	2.98	2.74	2.8	2.76	2.83	2.39	2.64	2.73	2.57
Std. Devn.	0.018	0.078	0.101	0.11	0.096	0.14	0.145	0.146	0.14	0.116	0.194	0.162	0.102	0.084	0.095
Variance	0	0.006	0.01	0.012	0.009	0.02	0.021	0.021	0.02	0.013	0.038	0.026	0.01	0.007	0.009
Co. of Variation	0.007	0.03	0.037	0.041	0.035	0.05	0.05	0.055	0.052	0.043	0.072	0.068	0.04	0.031	0.037

Sulfides	Granodiorite	Bolsa	Abrigo	Martin	Escabrosa	Horquilla	Earp (Lower)	Earp (Upper)	Epitaph	Scherrer	Glance	Gila	Arkose	Andesite	QMP
Assays	336	124	237	1,120	1,993	7,046	1,662	2,084	4,607	940	414	912	4,063	1,012	856
Missing Values	307	529	374	965	1200	11462	3603	3195	9238	1181	1126	871	6778	2035	640
Minimum	2.41	2.44	2.48	1.7	1.8	1.59	2.33	2.34	2.16	1.95	2.36	2.02	2.04	2.16	2.22
Maximum	2.85	2.92	3.2	3.37	3.43	3.7	3.78	3.17	3.59	3.4	3.24	2.74	3.77	3.09	3.17
Mean	2.583	2.609	2.745	2.723	2.719	2.817	2.83	2.674	2.735	2.747	2.708	2.379	2.545	2.698	2.622
1st Quartile	2.55	2.54	2.65	2.65	2.64	2.73	2.73	2.61	2.67	2.67	2.57	2.33	2.46	2.65	2.5
Median	2.57	2.59	2.71	2.71	2.7	2.82	2.84	2.67	2.74	2.72	2.73	2.39	2.53	2.71	2.59
3rd Quartile	2.61	2.65	2.87	2.79	2.78	2.9	2.93	2.73	2.81	2.81	2.83	2.42	2.61	2.76	2.73
Std. Devn.	0.062	0.09	0.132	0.132	0.134	0.127	0.146	0.106	0.123	0.136	0.174	0.084	0.117	0.104	0.164
Variance	0.004	0.008	0.017	0.017	0.018	0.016	0.021	0.011	0.015	0.019	0.03	0.007	0.014	0.011	0.027
Co. of Variation	0.024	0.034	0.048	0.049	0.049	0.045	0.051	0.04	0.045	0.05	0.064	0.035	0.046	0.039	0.063

Bulk Density Chart

ANVAL VALVES PVT LTD

Material	Lbs/cu.ft	Kgs/cu.m
Abrasive Compound	148	2371
Abrasive Mix	153	2451
Acetate	35	561
Acetate Flakes	21	336
Acrylic Fibres		144
Acrylic Resin	32	513
Activated Aluminium	15	240
Activated Carbon	20	320
Adipic Acid	40	641
Alcanol	39	625
Alfalfa Leaf Meal	15	240
Alfalfa Meal	17	272
Alfalfa Meal, Fine Ground	19	304
Alfalfa Pellets	42	673
Alfalfa Seed	46	737
Alumina	40	641
Alumina Powder	18	288
Alumina, Activated	48	769
Alumina, Calcined.	63	1009
Alumina, Metal Grade	67	1073
Aluminium Flake	150	2403
Aluminium Fluoride	55	881
Aluminium Magnesium Silicate	21	336
Aluminium Oxide	80	1282
Aluminium Powder	44	705
Aluminium Silicate	33	529
Aluminium Sulphate	65	1041
Ammonium Bromide	76	1218
Ammonium Chloride	38	609
Ammonium Nitrate	49	785
Ammonium Nitrate Pills	38	609
Ammonium Perchloride	62	993
Ammonium Phosphate	55	881
Ammonium Sulphate	69	1105
Amorphous Silica	11	176
Anthracite, Powdered	35	561
Antimony Oxide	44	705
Antioxidant (Granules)	41	657

Antioxidant (Powder)	28	449
Apple Slices Diced	15	240
Aquafloc	10	160
Arsenic Trioxide	41	657
Asbestos	22	352
Asbestos Fibre	20	320
Asbestos Powder	28	449
Ascorbic Acid (Coarse)	45	721
Ascorbic Acid (Fine)	32	513
Ash, Ground	105	1682
Ashes , Dry Loose	38	609
Ashes , Wet Loose	47	753
Baking Powder	56	897
Barbasco Root	33	529
Barites	120	1922
Barium Carbonate	55	881
Barium Oxide	63	1009
Barium Stearate	13	208
Barium Sulphate	60	961
Barley (Whole)	40	641
Barley Meal	28	449
Barley, Fine Ground	46	737
Barley, Ground	25	400
Barley, Malted	30	481
Barley, Rolled	23	368
Barley, Scoured	41	657
Bauxite	45	721
Beans (Soya)	46	737
Beans, White	45	721
Beet Pulp	18	288
Bentonite	50	801
Bicarbonate of Soda	62	993
Bleach Compound	60	961
Blood Flour	30	481
Blood Meal	38.5	617
Bone Meal Loose	55	881
Bone, Ground Dry	75	1202
Borax	60	961
Boric Acid	54	865
Bran	35	561
Brass Powder	100	1602

Bread Crumbs		96
Brewers Grains (Dry)	16	256
Bronze Powder	78	1250
Buckwheat (Whole)	38	609
Buckwheat Bran	16	256
Buckwheat Flour	41	657
Buckwheat Hulls	13	208
Buckwheat Middlings	22	352
Buttermilk Dried	31	497
Cake Mix	44	705
Calcium	30	481
Calcium Borate	61	977
Calcium Carbide, Crushed	80	1282
Calcium Carbonate	44	705
Calcium Chloride	60	961
Calcium Fluoride	102	1634
Calcium Hydroxide	40	641
Calcium Phosphate	48	769
Calcium Silicate	10	160
Calcium Stearate	20	320
Calcium Sulphate	45	721
Cane Seed	41	657
Carbon (Pelletised)	42	673
Carbon Activated	17	272
Carbon Black	35	561
Carbon Black (Beads)	19	304
Carbon Black (Pelletised)	22	352
Carbon Black Graphite	45	721
Carbon Crystallized	58	929
Carbon Dust	38	609
Carbon Granules	59	945
Casein	36	577
Caustic Soda	31	497
Cellulose Acetate	10	160
Cement	85	1362
Cement (Portland)	94	1506
Cement (Portland) Clinker	95	1522
Cement Dust	50	801
Ceramic Compound	85	1362
Cereal Mix	43	689
Charcoal (Powder)	24	384

Chemco Burnishing Compound	35	561
Chicory	34	545
Chicory (Powder)	30	481
Chilli Spice	45	721
Chlorine Compound	28	449
Chlorine Powder	36	577
Chocolate Drink Mix	26	417
Chromic Acid Powder	100	1602
Cinders, Blast Furnace	57	913
Cinders, Coal, Ashes & Clinker	40	641
Cinnamon Powder	35	561
Citric Acid	48	769
Clay	50	801
Clay (Bentonite)	50	801
Clay (Calcined)	30	481
Clay (Fine)	62	993
Clay (Fines)	70	1121
Clay (Granite)	32	513
Clay (Kaolin)	48	769
Clinker Dust	90	1442
Clover Seed	48	769
Coagulant	36	577
Coal (Granules)	52	833
Coal (Pulverized)	38	561
Coal Anthracite	58	929
Coal Bituminous	52	641
Coal Dust	35	561
Coal Powder	40	641
Cobalt Carbonate	60	961
Cobalt Fines	256	4101
Cocoa	35	561
Cocoa Flavouring	55	881
Cocoa Shells	30	481
Coconut Chips	38	609
Coffee (Instant)	19	304
Coffee, Green (Beans)	38	609
Coffee, Roasted (Beans)	23	368
Coke (Granules)	52	833
Coke Dust	15	240
Coke Fines	39	625
Coke, Calcined (Course)	56	897

Coke, Calcined (Fines)	59	945
Coke, Calcined (Intermediate)	59	945
Coke, Pulverised	45	721
Copper (Fines)	101	1618
Copper Hydroxide	25	400
Copper Sulphate	52	833
Copra Meal, Loose	27	433
Cork, Solid	15	240
Corn Bran	13	208
Corn Flour	51	817
Corn Germ Meal	35	561
Corn Gluten Feed	29	465
Corn Gluten Meal	37	593
Corn Grits	42	673
Corn Mash	45	721
Corn Meal	40	641
Corn Oil Meal	34	545
Corn Starch	42	673
Corn, (Whole shelled)	45	721
Corn, Chops (Coarse)	42	673
Corn, Chops (Fine)	38	609
Corn, Chops (Medium)	40	641
Corn, Cracked (Coarse)	40	641
Corn, Ground	35	561
Corn, Hominy Feed	27	433
Corn, Kibbled	21	336
Cottonseed Cake	42	673
Cottonseed Delinted	30	481
Cottonseed Flour	56	897
Cottonseed Hulls	12	192
Cottonseed Meats	40	641
Cryolite	86	1378
Detergent (Flake)	32	513
Detergent (Powder)	38	609
Dextrose	36	577
Diammonium Phosphate	50	801
Diatomaceous Earth	16	256
Diatomite	14	224
Dicalite	12	192
Dielectric Compound	45	721
Distillers Grains	18	288

Dolomite	54	865
Dolomite Lime	46	737
Egg Yoke Powder	23	368
Eggs (Powdered)	22	352
Electrolyte	60	961
Epoxy Powder	49	785
Ferric Chloride	43	689
Ferric Sulphate	61	977
Ferro Silicate	78	1250
Ferro Silicon	87	1394
Ferrous Carbonate	87	1394
Fibreglass	22	352
Filter Cake (Centrifuge)	40	641
Fish meal	38	609
Flaxseed	44	705
Flint	97	1554
Floc	13	208
Floc (Solka)		144
Flour	48	769
Flour (Barley Malt)	45	721
Flour (Barley)	38	609
Flour (Corn)	39	625
Flour (Rye)	42	673
Flour (Soy)	44	705
Flour (Soya)	40	641
Flour (Wheat)	42	673
Fluorite	78	1250
Fluorspar	112	1794
Flux	145	2323
Fly Ash	65	1041
Fullers Earth	35	561
Fumaric Acid	40	641
Garlic (Flakes)	22	352
Garlic (Powder)	20	320
Gelatine	45	721
Glass (Ground)	103	1650
Glass (Powder)	103	1650
Glass Beads	100	1602
Glass Microspheres	62	993
Gold Powder	53	849
Grain	36	577

Granite, Crushed	97	1554
Graphite	48	769
Graphite (Flakes)	42	673
Graphite (Granules)	68	1089
Graphite (Powder)	35	561
Graphite (Pulverized)	22	352
Gravel	110	1762
Grinding Compound	99	1586
Ground Bone	50	801
Gum Base	42	673
Gum Granules	36	577
Gum Resin	32	513
Gypsum	54	865
Gypsum (Calcined)	55	881
Gypsum (Ground)	42	673
Ice, Crushed	40	641
Iron Chromite	114	1826
Iron Fillings	180	2884
Iron Ore	162	2595
Iron Oxide	80	1282
Iron Oxide (Black)	161	2579
Iron Oxide (Red)	69	1105
Iron Powder	175	2804
Iron Sulphate	80	1282
Kaolin	49	785
Kaolin Clay	50	801
Latex Powder	89	1426
Lead Arsenate	90	1442
Lead Carbonate	81	1298
Lead Chloride Crystals	72	1153
Lead Oxide	63	1009
Lead Stabilizer	43	689
Ligno Sulfinate	30	481
Lignone	36	577
Lignosol	24	384
Lime	35	561
Lime (Dolomitic)	42	673
Lime (Granular)	80	1282
Lime (Hydrated)	40	641
Lime (Pebble)	45	721
Lime (Pulverised Quick)	60	961

Lime (Quick)	55	881
Limestone	60	961
Limestone (Ground)	59	945
Limestone (Pulverised)	68	1089
Limestone Dust	69	1105
Limestone Filler	63	1009
Limestone Flour	69	1105
Linseed Meal	25	400
Liquorice Powder	28	449
Magnesia	78	1250
Magnesite	27	433
Magnesite Light	40	641
Magnesium Carbonate	12	192
Magnesium Chips	60	961
Magnesium Chloride	12	192
Magnesium Hydroxide	39	625
Magnesium Oxide	65	1041
Magnesium Silicate	58	929
Magnesium Stearate	21	336
Magnesium Sulphate	52	833
Magnetite	165	2643
Malted Barley Flour	40	641
Malted Wheat Flour	41	657
Manganese Dioxide	70	1121
Manganese Ore	110	1762
Mannitol	38	609
Marble (Granular)	80	1282
Marble (Ground)	93	1490
Meat Meal	37	593
Melamine	45	721
Melamine Powder	32	513
Metallic Flakes	35	561
Metallic Powder	165	2643
Metasol	38	609
Mica (Flakes)	10	160
Mica (Powder)	41	657
Milk (Powdered Whole)	35	561
Milk (Powdered)	13	208
Milk (Whole)	32	513
Millet	40	641
Milo, Ground	34	545

Molasses Feed	22	352
Molding Sand	75	1202
Molybdenum Disulfide	44	705
Molybdenum Oxide	98	1570
Molybdi Oxide	16	256
Monosodium Phosphate	55	881
Naphthalene Flakes	36	577
Natrosol	28	449
Nickel	60	961
Nickel Oxide	28	449
Nickel Powder	75	1202
Nuts (Almond)	29	465
Nuts (Cashews)	31	497
Nuts (Peanuts)	33	529
Nylon Fibres	10	160
Nylon Flakes	32	513
Nylon Pellets (1/8")	35	561
Nylon Powder	39	625
Oat Flour	33	529
Oat Middlings	38	609
Oats	27	433
Oats (Ground)	29	465
Oats (Rolled)	22	352
Oats Groats (Whole)	46.5	745
Oats, Hulls		128
Onions (Chopped)	14	224
Onions (Minced)		128
Onions (Powdered)	25	400
Oxalic Acid	52	833
Oxychloride	36	577
Oyster Shell (Ground, - 0.5")	53	849
Peanut Brittle	36	577
Peanut Meal	28	449
Peanuts (Shelled)	43	689
Peanuts (Unshelled)	21	336
Peat Moss	10	160
Peppermint Powder	34	545
Peppers (Chopped)	21	336
Peppers (Whole)	16	256
Perlite	15	240
Perlite filter Aid		128

Perlite Ore	65	1041
Petroleum Coke	55	881
Petroleum Coke Dust	25	400
Phenofil	30	481
Phenol Formaldehyde	30	481
Phenolic Powder	32	513
Phosphate	80	1282
Phosphate Rock Crushed	69	1105
Phosphate Rock Dust	90	1442
Phosphate Rock ground	70	1121
Plaster Of Paris	49	785
Plastic (Beads)	46	737
Plastic (Cubes)	38	609
Plastic (Flakes)	48	769
Plastic (Pellets)	45	721
Plastic Powder	42	673
Plastic Resin	40	641
Polyamide Resin	31	497
Polycarbonate Resin	44	705
Polyester Adhesive Powder	30	481
Polyester Flakes	27	433
Polyester Resin	34	545
Polyethylene	43	689
Polyethylene Beads	42	673
Polyethylene Film		128
Polyethylene Flakes		96
Polyethylene Granular	30	481
Polyethylene Pellets	35	561
Polyethylene Powder	35	561
Polyhedral Alcohol	37	593
Polymer	20	320
Polymer Reagent	39	625
Polymer Resin	38	609
Polypropylene	30	481
Polypropylene Pellets	32	513
Polypropylene Powder	33	529
Polypropylene Flakes	22	352
Polystyrene Beads	40	641
Polystyrene Pellets	38	609
Polystyrene Powder	33	529
Polyurethane Pellets	45	721

Polyvinyl Acetate	39	625
Polyvinyl Alcohol	39	625
Polyvinyl Chloride	41	657
Polyvinyl Chloride Pellets	39	625
Potassium Bromide (5%Moist)	114	1826
Potassium Carbonate (Potash)	74	1185
Potassium Chloride	60	961
Potassium Iodate	129	2067
Potassium Muriate	66	1057
Potassium Sulphate	90	1442
Potatoes (Flakes)	13	208
Potatoes (Powdered)	48	769
Potting Soil	16	256
Poultry Meal	36	577
Powdered Sugar	35	561
Pumice Powder	39	625
PVC Chips	54	865
PVC Resin	32	513
Raisins (Moist)	38	609
Rapeseed	48.3	774
Red Lead	165	2643
Red Oxide Pigment	72	1153
Rice	45	721
Rice (Puffed)		96
Rice Bran	26	417
Rock Salt	68	1089
Rubber (Granules)	28	449
Rubber Composition Powder	34	545
Rubber Compound	38	609
Rubber Crumb	22	352
Rubber Foam (Chopped)		48
Rubber Powder	33	529
Rye Bran	18	288
Rye Feed	33	529
Rye, Malted	32	513
Rye, Middlings	42	673
Rye, Shorts	33	529
Rye, Whole	44	705
Salt, Fine Table	86	1378
Salt, Granulated	80	1282
Sand	99	1586

Sand (Dry)	110	1762
Sand (Fine)	125	2002
Sand (Foundry)	100	1602
Sand (Moist)	130	2083
Sand (Molding)	78	1250
Sand Foundry, Coarse	96	1538
Sand Foundry, Fine	104	1666
Sawdust (Coarse)	25	400
Sawdust (Fine)	18	288
Sawdust (Moist)	28	449
Seed (Grass)	40	641
Shellac Resin	81	1298
Silica Flour	80	1282
Silica Gel	42	673
Silica Sand	81	1298
Silicon Carbide	45	721
Silicon Dioxide		48
Silver (Powder)	69	1105
Slate (Crushed)	100	1602
Soap Flakes	29	465
Soap Powder	36	577
Soapstone	47	753
Soda Ash	54	865
Soda Ash-Iron Chromite	77	1234
Sodium Aluminate	61	977
Sodium Benzoate	47	753
Sodium Bicarbonate	50	801
Sodium Bisulphate	90	1442
Sodium Borate	77	1234
Sodium Caseinate	21	336
Sodium Chloride	80	1282
Sodium Chloride	83	1330
Sodium Hydrosulphate	70	1121
Sodium Hydrosulphite	73	1169
Sodium Hydroxide	60	961
Sodium Metasilicafe	70	1121
Sodium Naptholine Sulph.	27	433
Sodium Nitrate	84	1346
Sodium Perborate	53	849
Sodium Pyrophosphate	63	1009
Sodium Silicate	32	513

Sodium Sulphate	85	1362
Sodium Sulphite	102	1634
Sodium Thiosulfate	55	881
Sodium Tripolyphosphate	60	961
Soybean Flakes	36	577
Soybean Hulls	25	400
Soybean Meal	40	641
Starch (Corn)	43	689
Stearic Acid (Flakes)	32	513
Stearic Acid (Powder)	36	577
Styrene Beads	45	721
Sucrose	53	849
Sucrose Octoacetate	33	529
Sugar (Beet)	50	801
Sugar (Dextrose)	39	625
Sugar (Granulated)	44	705
Sugar (Powdered)	35	561
Sulphur	45	721
Sulphur (Granular)	70	1121
Sunflower Seed	38	609
Talcum Powder	55	881
Tantalum Powder	40	641
Tea	27	433
Tea (Flakes)	24	384
Tea (Powdered)	27	433
Teflon (Fibre)	30	481
Teflon (Granules)	36	577
Teflon (Powdered)	29	465
Teflon Pellets	60	961
Terepthalic Acid	30	481
Thiamine	47	753
Thionex	30	481
Thorium Oxide	62	993
Titanium Dioxide	48	769
Tobacco (Cigarette)	12	192
Tobacco (Powdered)	28	449
Tricalcium Phosphate	35	561
Trichicrocyanuric Acid	50	801
Tripolyphosphate	80	1282
Trisodium Phosphate	50	801
Tumaric (Acid Fines)	51	817

Tungsten Carbide	250	4005
Uranium (Compound)	191	3060
Uranium (Granules)	184	2948
Uranium Oxide	108	1730
Urea	42	673
Urea Formaldehyde	36	577
Urea Powder	39	625
Urea Prills	45	721
Vermiculite	62	993
Vinyl Acetate	36	577
Vinyl Chips (Irregular)	20	320
Vinyl Compound	36	577
Vinyl Powder	34	545
Vinyl Resin	36	577
Wax (Flake)	50	801
Wax (Powder)	38	609
Wheat (Hulls)	44	705
Wheat (Shaved)	34	545
Wheat Flour	30	481
Wheat Gluten	43	689
Wheat Middling	15	240
Wheat, Cracked	35	561
Wheat, Whole	49	785
Whey	35	561
White Lead	85	1362
Wood Chips	30	481
Wood Flour	20	320
Wood Shavings	10	160
Yeast	59	945
Zinc Ammonium Chloride	66	1057
Zinc Carbonate	35	561
Zinc Oxide	55	881
Zinc Powder	210	3364